Results of FY07 COG/TPB Travel Forecasting Research: Detailed Topics, Part 1

Presentation to Travel Forecasting Subcommittee

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Phil Shapiro, P.E., PTOE, Principal in Charge – pshapiro@vhb.com
Paul Gilliam, P.E., PTOE, Senior Transportation Engineer -- pgilliam@vhb.com
Rich Roisman, AICP, Senior Transportation Planner – rroisman@vhb.com

FY 07 TPB Travel Forecasting Research Topics and Presentation Schedule (1)

- July 20, 2007 TFS meeting: overview
- Today: detailed presentations on three topics
  - Cutlines for model validation
  - Traffic count database and peak spreading
  - Microsimulation and DTA

FY 07 TPB Travel Forecasting Research Topics and Presentation Schedule (2)

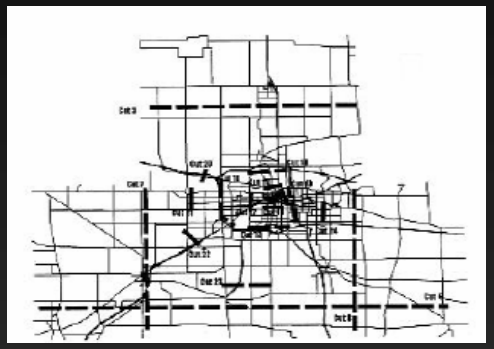
- November 16, 2007 TFS meeting: detailed presentations on three topics
  - Summit
  - Nested Logit / Feedback
  - Equilibrium Assignment

Cutlines for Model Validation

Purpose: review the use of cutlines for model validation.

“Screenlines” is a Generic Term

- Cutline: captures major flows through a corridor
- Screenline: captures cross-regional flows
  - Potomac River
- Cordon: polygon encloses study area
  - Beltway, Metro Core



Source: Barton-Aschman / Cambridge Systematics (1997)

Literature Review / MPO Practice

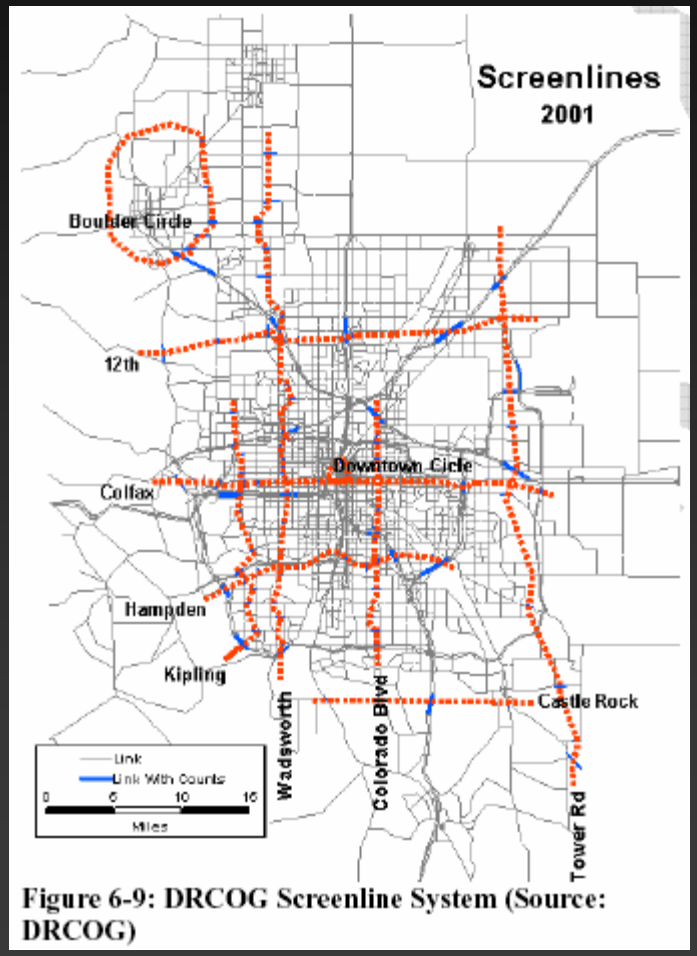


Figure 6-9: DRCOG Screenline System (Source: DRCOG)

- Primary guidance: NCHRP 255
  - Followed by most MPOs
- Actual number of screenlines varies by MPO size / geography, professional practice

Other MPO Screenlines (1)

- TPB: 38 regional screenlines plus external cordon
- ARC: 22 regional screenlines
  - Maximum desirable deviation standards taken from NCHRP 255
  - Applied using TP+ script
- DRCOG: 8 regional screenlines
  - Cordons for downtown Denver and City of Boulder

Other MPO Screenlines (2)

- BMC: 52 screenlines divided into 4 categories
  - 12 Baltimore City screenlines
  - 24 Circumferential screenlines
  - 11 Corridor screenlines
  - 5 Local Area Cordons
    - Columbia, Towson, Westminster, Bel Air, Annapolis

Other MPO Screenlines (3)

- RTC (Las Vegas): 71 screenlines
- NYMTC: >100 screenlines
- MTC (San Francisco): screenlines at all county borders
  - Intervening screenlines within certain counties
  - Screenlines for each of eight bay crossings

Other MPO Screenlines (4)

- PSRC: 71 screenlines
- SCAG: 16 regional screenlines
- MAG (Phoenix): 74 screenlines
- Central Florida: 54 regional cutlines

NCHRP 255: Highway Traffic Data for Urbanized Project Planning and Design

- "the bible" – widely used nationally
- Every other guidance document uses 255 guidelines as base
- Few, if any MPOs radically depart from 255 guidelines

NCHRP 255 Guidelines: Selecting Cutlines

- Cutline should capture traffic on all alternative roadways in a corridor
- Cutline should cross between 3-7 facilities, 10 is practical maximum
- Recommended length: 2-5 miles, depending on area density
- Place between major roadway interchanges

NCHRP 255 Guidelines: Base Year Data Checks

- Compare modeled / observed volumes by screenline
- Maximum desirable deviation between modeled / observed
  - Report includes curves for individual count locations and screenlines
- Inverse relationship between screenline volume and percentage deviation

NCHRP Guidelines: Correcting Problems

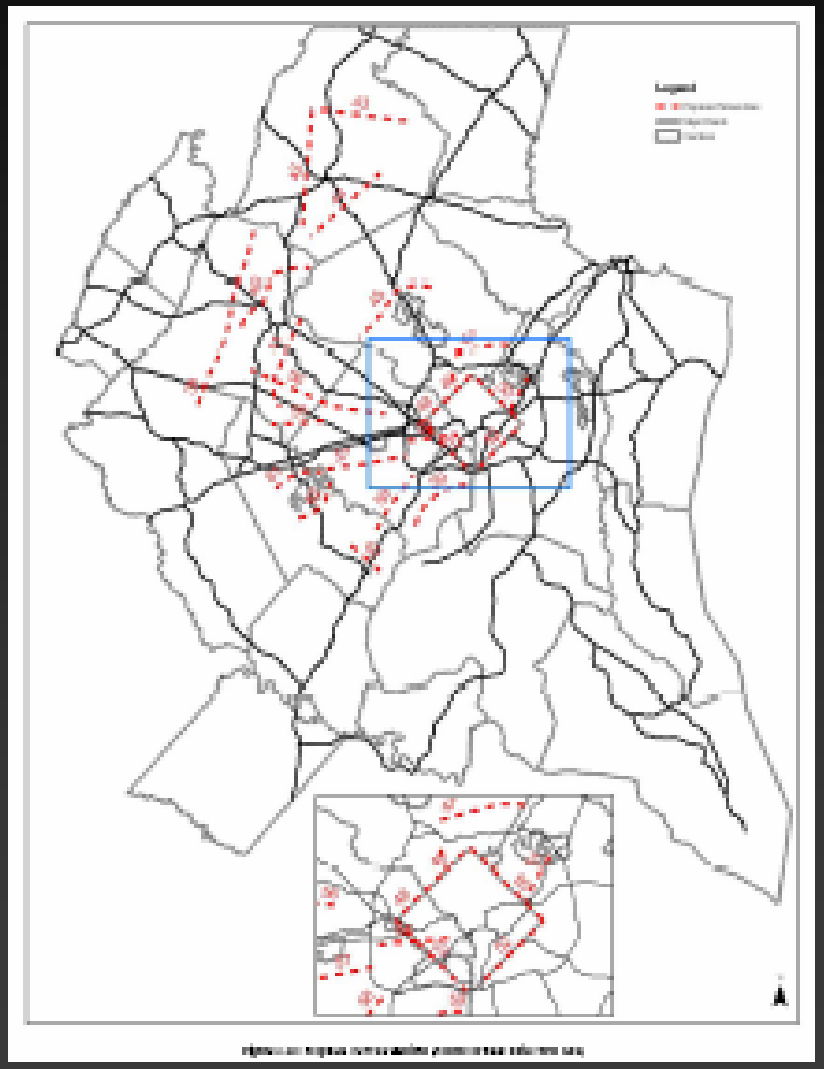
- QA/QC of model; re-run model
- Extend screenline; check for consistent travel market
- Factor screenline volumes
  - Difference between assignment and counts
- Adjust forecast volumes

Proposed New Screenlines: Methodology

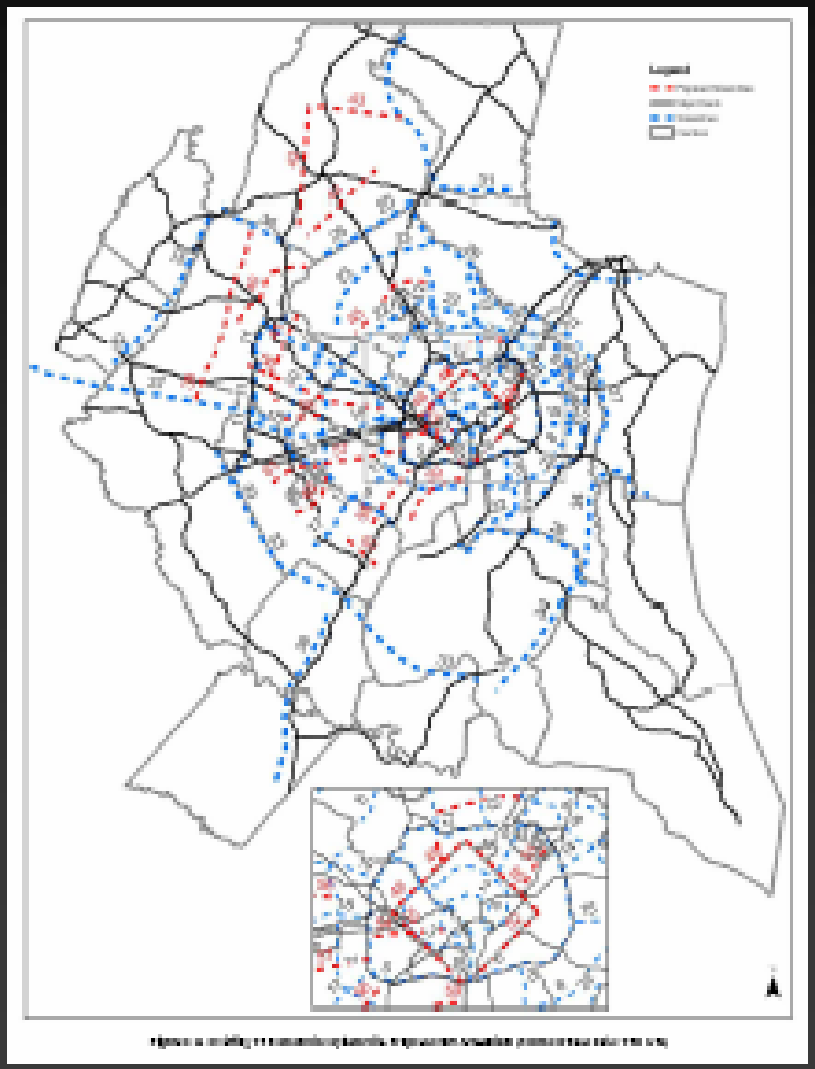
- Review existing screenlines
- Consider changes in travel markets
- Overlay existing screenline system on CLRP projects
- Check new screenlines against NCHRP 255 guidelines

Proposed New Screenlines: Maps

New



New + Existing



Proposed New Screenlines (1)

Screenline Number	Location	Justification
39	Western Loudoun	Population / Employment Growth
40	North / West of Leesburg	Population / Employment Growth
41	East of Leesburg	Growth; potential future studies of VA 7 and Dulles Greenway
42	West of City of Frederick	Extra-regional growth in Washington County; emergence of Frederick County as employment / shopping destination
43	North of City of Frederick	Extra-regional growth in Pennsylvania; emergence of Frederick County as employment / shopping destination
44	South / East of City of Frederick	Supplement for studies in I-270 and I-70 corridors
45	Germantown	Supplement for project planning studies in I 270 corridor

Proposed New Screenlines (2)

Screenline Number	Location	Justification
46	Extension of Screenline 12 to District of Columbia line	Capture east-west flows across Rock Creek inside the Capital Beltway
47	Wheaton / Fairland	Demographic changes in this section of Montgomery County
48	Ten Mile Square NW (Arlington / Fairfax Section)	Supplement to Screenline 3; easier boundary to manage
49	Ten Mile Square NW (Montgomery / DC Section)	Supplement to Screenline 2; easier boundary to manage
50	Ten Mile Square NE (Montgomery, Prince George's, DC)	Supplement to Screenline 2; easier boundary to manage
51	West of MD 295	Few crossing streets
52	Ten Mile Square SE (Prince George's / DC)	Supplement to Screenline 4
53	Ten Mile Square SW (Fairfax / Alexandria / Arlington)	Supplement to Screenline 3; better capture movements within Alexandria

Proposed New Screenlines (3)

Screenline Number	Location	Justification
54	Annandale / US 50	Better capture movements to east-west travel corridor inside Beltway in Northern Virginia
55	Extension of Screenline 37	Growth in area
56	North-South Screenline for SE Loudon and NW Fairfax	Better capture travel between VA 267 and US 50 / I-66 corridors
57	Burke / Clifton	Supplement to Screenline 17; better capture travel from south to I-66 / US 50 corridor
58	2nd ring, west of I-95	Nearby transportation improvements
59	2nd ring, east of I-95	Fort Belvoir / improvements
60	I-95 north of VA 234	Nearby transportation improvements; growth in Prince William County
61	Manassas West	Nearby transportation improvements; growth in Prince William County
62	Manassas East	Nearby transportation improvements; growth in Prince William County

Results of 2005 Model Run at Selected Screenline Locations

- Year 2005 model run completed (v2.1D#50)
- Estimated / observed comparison in I-270 and I-66 corridors
  - Maximum desirable deviation derived from NCHRP 255
- Most results within acceptable levels
- More observed data needed at some locations

Estimated/Observed 2005 Volumes I-270 Corridor

Screenline / Location	Estimated Volume	Observed Volume	Deviation	Maximum Desirable Deviation
44 Southern Frederick	*119,126*	*107,450*	*11%*	*23%*
25 Montgomery / Frederick Line	115,290	121,176	5%	22%
23 Clarksburg / Northern Montgomery	26,670	36,632	27%	39%
45 Germantown	339,014	309,775	9%	14%
22 Gaithersburg (W of Screenline #12)	344,556	351,462	2%	12%
8 Rockville	303,988	342,863	11%	12%
6 Beltway Cordon	209,789	219,858	5%	17%
49 Ten-Mile Sq NW (Montgomery / DC Line btw Screenlines 46 and Potomac River Screenline)	185,222	132,475	40%	21%

Estimated/Observed 2005 Volumes I-66 Corridor

Screenline / Location	Estimated Volume	Observed Volume	Deviation	Maximum Desirable Deviation
11 US 15 / Eastern Loudoun	192,406	181,000	6%	19%
41 East of Leesburg	142,522	126,000	13%	22%
10 Riding	91,460	69,600	31%	29%
9 Chantilly	492,958	417,200	18%	10%
7 E of Fairfax City	473,868	494,000	4%	7%
5 Beltway Cordon	395,312	431,000	8%	9%
48/53 Ten Mile Sq NW / SW	231,714	221,600	5%	17%

Comments

- TPB should consider placement of the recommended screenlines
  - Observed data at some locations still problematic
  - However, much data yet to be mined
  - May need phased approach
- Screenlines should be multimodal
  - Need for more observed transit data

Comments (2)

- TPB must balance needs
  - Regional screenlines
  - Project-level cutlines
- Validation procedures can be used for model sensitivity testing
- Possible Local Area Cordons?

Peak Spreading

Purpose: review State of the Practice and state of the art with regards to modeling peak spreading at the MPO level.

State of the Practice (1)

- Most MPOs apply time-of-day factors to daily trip tables coming out of mode choice
- Factors typically derived from household survey and validated with traffic counts

State of the Practice (2)

- Most MPOs post-process assignment results for conformity analysis
  - Address unrealistically low speeds
  - Address over-assigned links
- These (and previous slide) methods currently applied by TPB

TPB Peak Spreading Method

- AM peak, PM peak, off-peak trip tables
- Assign to network
  - Congested skims for peak periods
  - Apply VDFs
- Post-processor divides final assignments into hourly increments
  - If volume exceeds link capacity, excess volume shifted to adjacent hours; link speeds updated

Limitations to State of the Practice (1)

- Regional time-of-day factors do not capture temporal, geographic variations in demand
  - I-270 and US 50 have different peaking characteristics
- Time-of-day factors applied to entire peak period
  - Does not capture variation of demand within the peak period
  - Several large MPOs also use this method, including SCAG, BMC, and SEMCOG

Limitations to State of the Practice (2)

- Time-of-day factors do not “see” congestion
  - Regional factors applied despite large variation in congestion patterns
  - Factors not adjusted based on congestion
    - No feedback from assignment to post-mode choice
- Impacts of traffic control and network constraints not considered in VDFs

MPO Variations to Mitigate Limitations to State of the Practice (1)

- NCTCOG uses a modified VDF that creates a link speed floor
  - Prevents unrealistically low speeds from entering feedback loop
  - Could create problems with assignment convergence
  - Does create problems with FTA new starts modeling

MPO Variations to Mitigate Limitations to State of the Practice (2)

- Portland Metro uses additional assignment time periods
  - 3 hour AM peak period
  - 2 hour AM peak period
  - 4 hour PM peak period
  - 2 hour PM peak period
  - Gives better approximation of “peak within the peak” demand
  - Still subject to time-of-day factor limitations

State of the Art -- PSRC

- 3-hour peak period assignment includes factor to allocate volume to worst hour for calculating delay
- TOD model calculates shares of trips
  - By time period and direction
  - For all home-based auto trips
  - Zone-to-zone

State of the Art -- MTC

- Binomial logit: AM peak (2 hour) or non-AM peak departure
- Choice estimated using 1990 HTS
- Assignments calibrated / validated to 1990 volumes / speeds
- Tendency to divert trips from peak period to shoulders
  - "Snow plow" effect
  - Solution: add 4 hour AM peak assignment
  - Apply slower of 2 hour or 4 hour assignment for feedback to mode choice

State of the Art -- MORPC

- Activity-based model
- Joint application of logit based models
  - Tour desination choice
  - Tour mode choice
    - Logsum measure available to other choice models for sensitivity to congestion
  - Time of day choice

MORPC Time of Day Choice Model

- Hybrid discrete choice departure time / duration model
- Based on “time windows” concept
- Allocation based on 16 hour per person time budget
- Temporal resolution of 1 hour for modeled period (5:00AM to 11:00PM)
- Departure time of each tour
- Duration of each activity associated with tour
  - Departure / arrival times on both tour legs constrained by activity duration and travel time

Potential Approach for TPB (1)

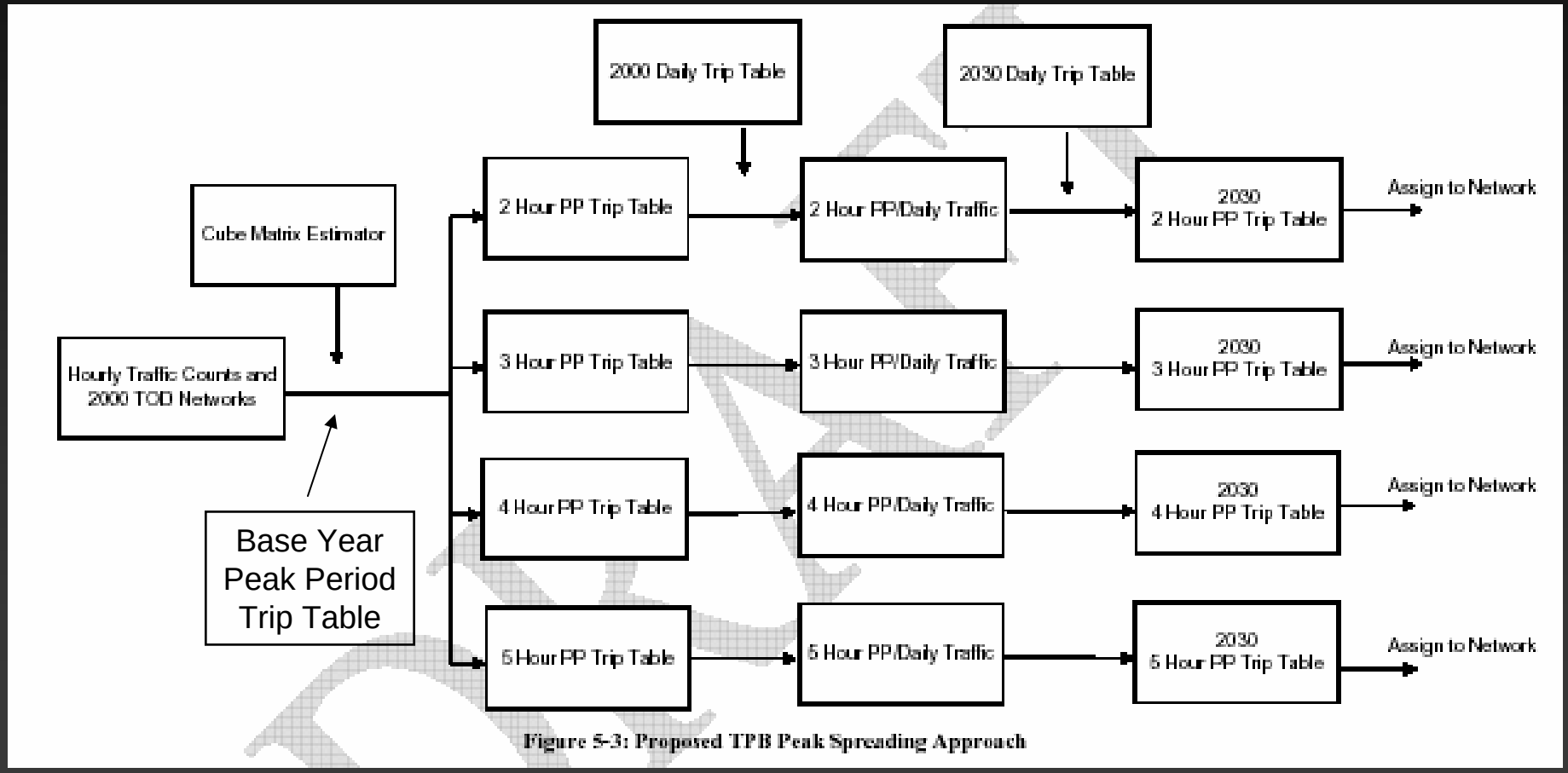


Figure 5-3: Proposed TPB Peak Spreading Approach

Potential Approach for TPB (2)

- Begin with validated base year model
- Obtain hourly traffic counts at screenlines
  - From VDOT / MDOT / DDOT
  - Many locations available
  - Requires more effort than locating ADTs
- Estimate OD tables for 2, 3, 4, and 5 hour peak periods
  - Use Cube Matrix Estimator
  - Peak period forecast as seed

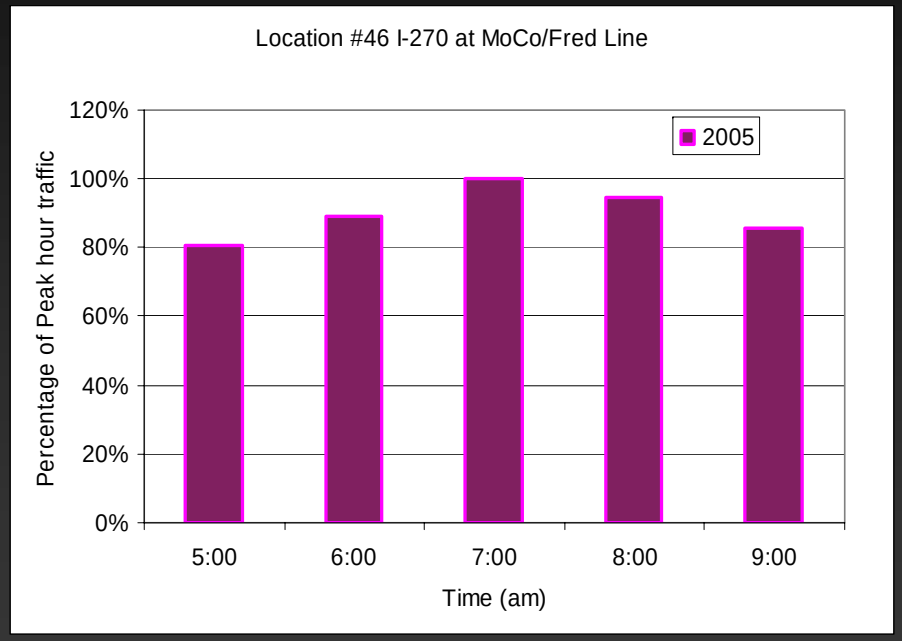
Potential Approach for TPB (3)

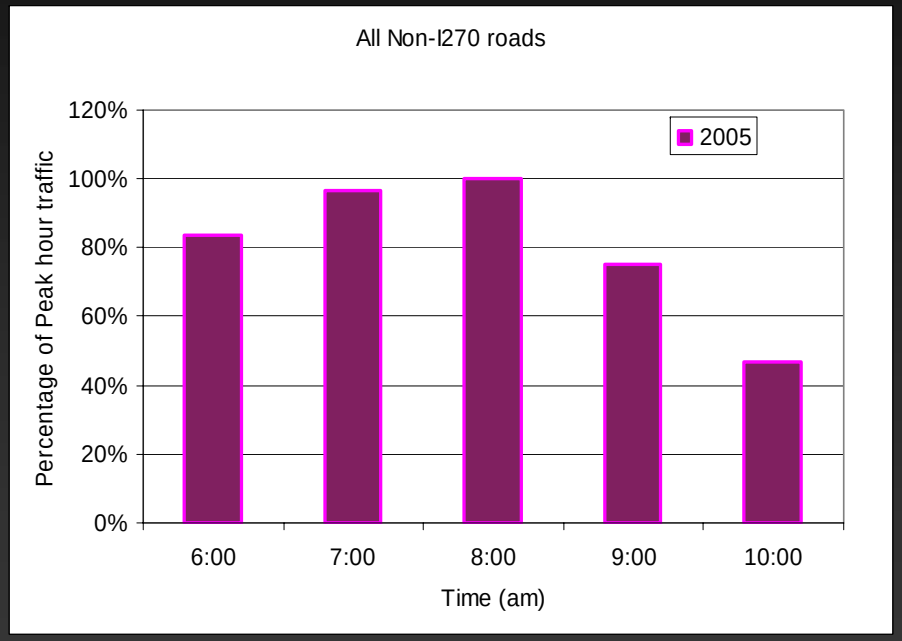
- Divide by regional daily OD table
  - Creates four peak period OD tables
  - Reflect percentage of peak period to daily travel
  - Based on existing regional traffic counts
- Assign new peak period tables to network
  - Use congested skims

Potential Approach for TPB (4)

- Examine duration of peak period
  - Conduct two-hour assignment and plot resulting V/C ratios
  - V/C based on hourly capacity*hours in time period
  - If V/C exceeds threshold (for example 1.1) then move to three-hour assignment
  - Iterate until extent of peak period reached

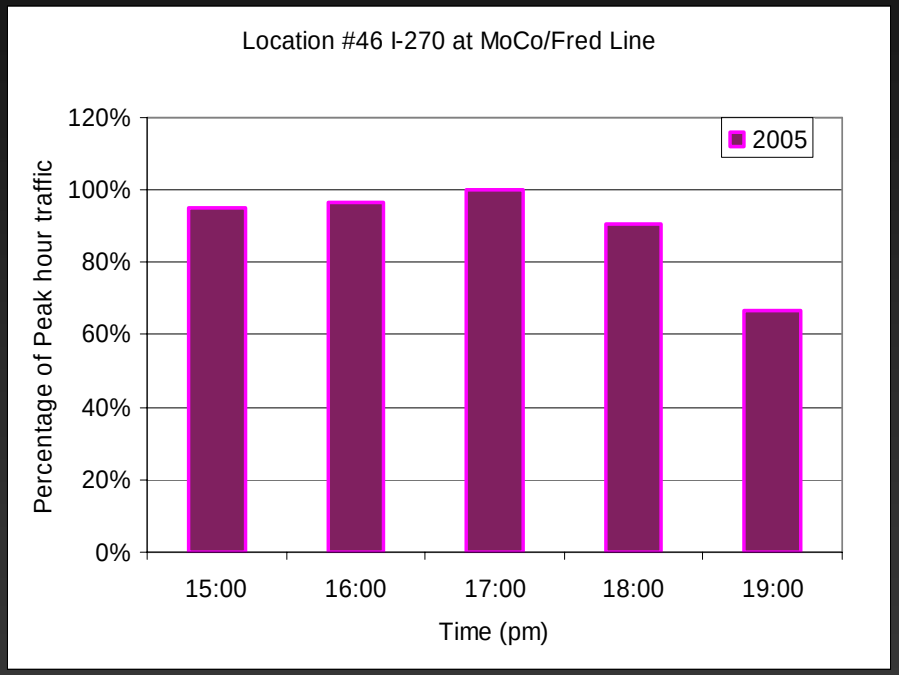
Observations of AM Peak Spreading in the I-270 Corridor

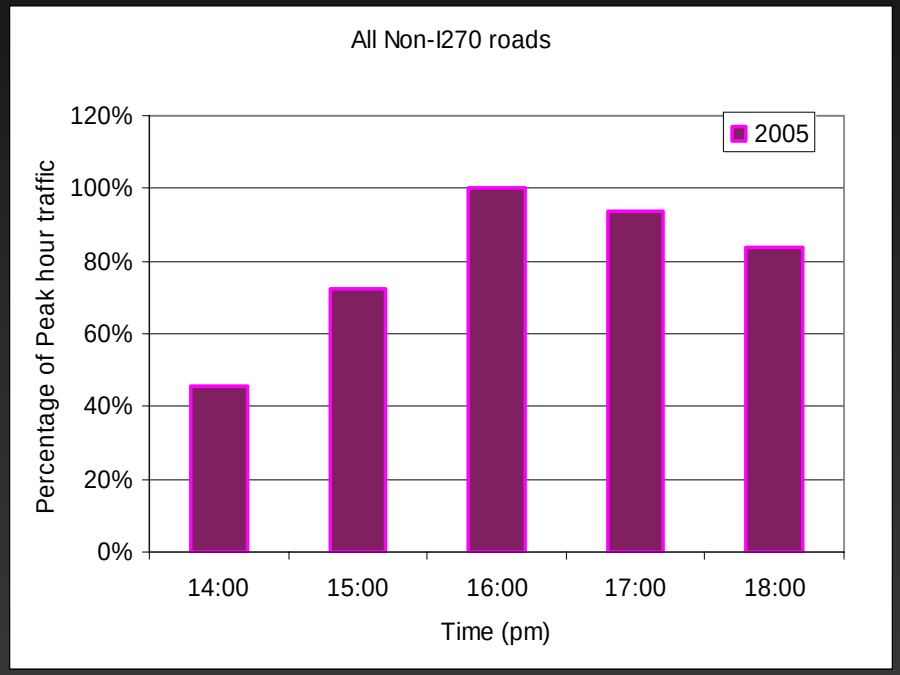




Screenline 25: Montgomery County / Frederick County Line

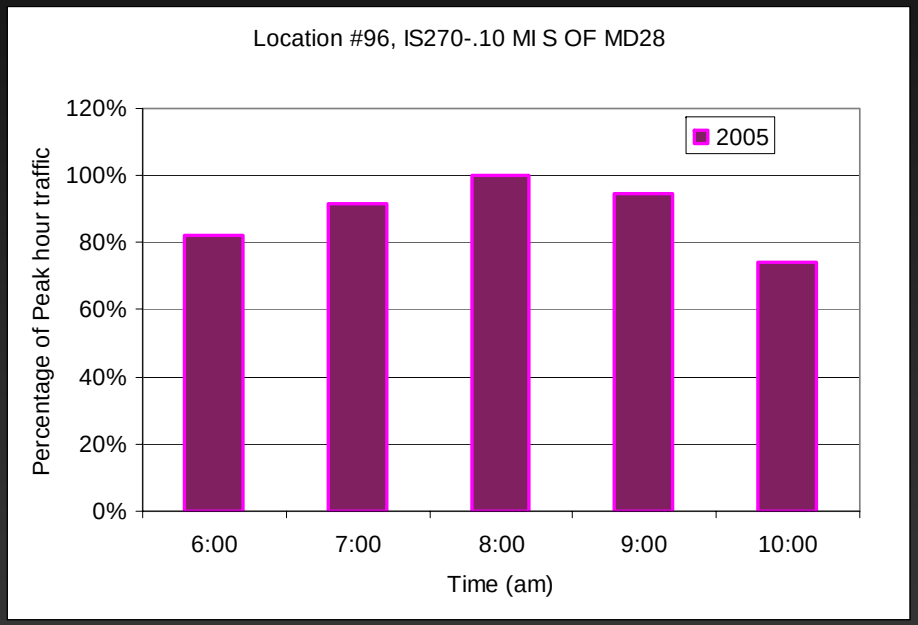
Observations of PM Peak Spreading in the I-270 Corridor

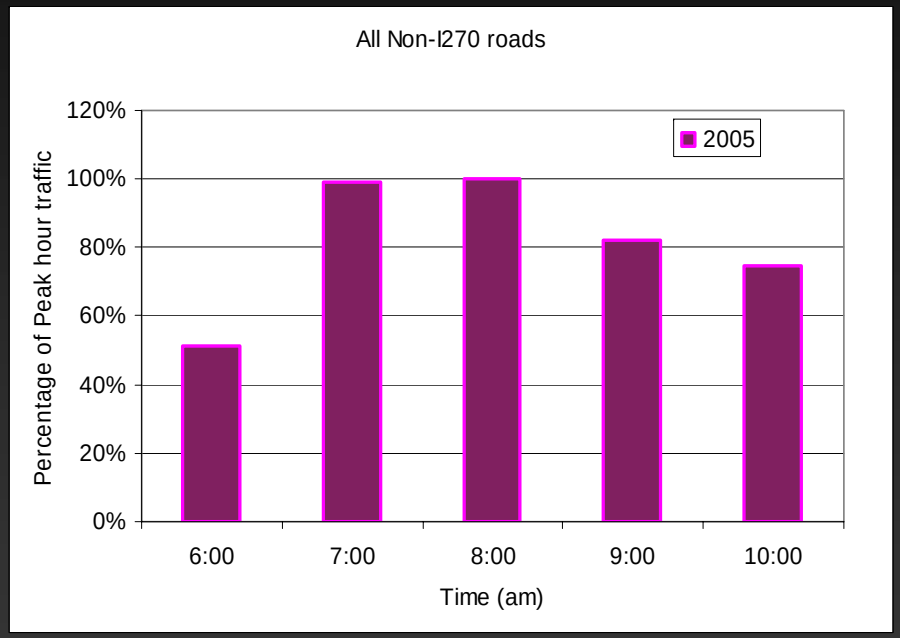




Screenline 25: Montgomery County / Frederick County Line

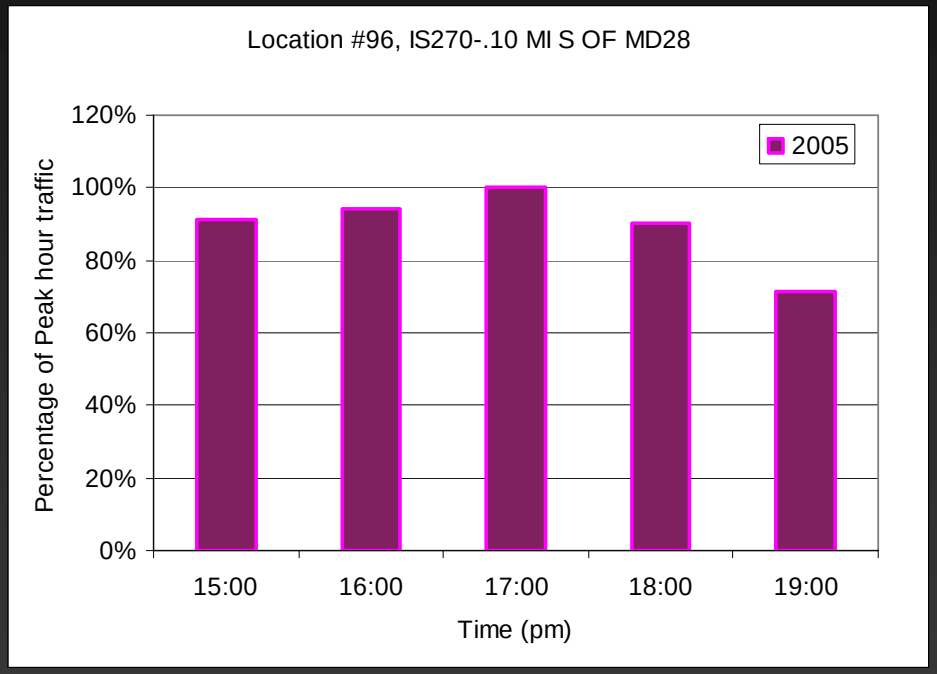
Observations of AM Peak Spreading in the I-270 Corridor (2)

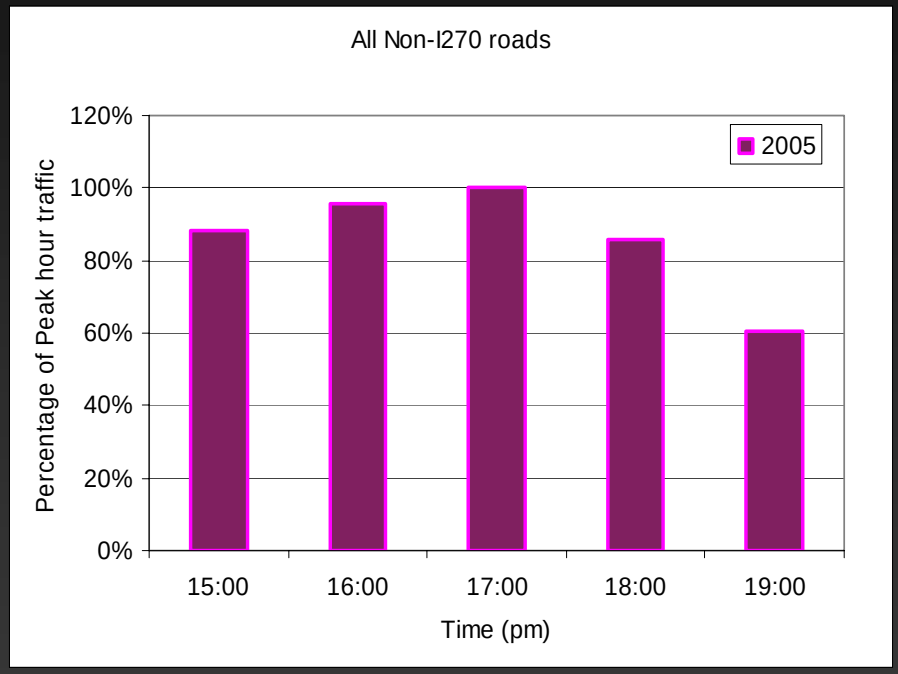




Screenline 8: I-270 at MD 28

Observations of PM Peak Spreading in the I-270 Corridor (2)





Screenline 8: I-270 at MD 28

Maps of Traffic Count Inventory

- Good coverage along Capital Beltway and I-270 corridors in Maryland
- Good coverage along I-95 and I-66 corridors in Virginia
- Good coverage at District of Columbia line in Upper NW and Upper NE
- Details in large format maps (along wall)

DTA / Simulation

Purpose: review the use of traffic simulation and DTA models among MPOs.

Before Selecting a Tool….

- Define the problem:
  - Intersection operations
  - Arterial congestion
  - Freeway Weaving
  - Transit Priority
  - ITS
  - Incidents

Simulation Models

- Most Commonly used software:
  - Synchro/SimTraffic
  - CORSIM
  - VISSIM

Synchro/SimTraffic

- Ideal for traffic operational analysis
- Signal Timing Optimization
- Signal System Coordination
- Can be “tricked” to evaluate special conditions such as rail crossing, toll booths
- Limited Freeway Analysis
- 3-D Animation
- Most popular in US based on survey

CORSIM

- FHWA developed in 1970's
- Integrated freeway and arterial analysis
- Manual signal timing optimization
- Can evaluate most freeways
- HOV
- Freeway Incidents
- Ramp Metering

VISSIM

- Most effort to code-more control of intersection calibration
- Transit Priority
- Large Networks
- Ideal for non-conventional intersections/interchanges
- Dynamic Traffic Assignment Capabilities-ETL and Managed Lane evaluation

Other Simulation Software

- Paramics-Reads OD Table only, no explicit turning movements
- AIMSUN-Compares favorably to VISSIM
- Transmodeler-Caliper recently introduced
- Cube Dynasim-Citilabs

DTA Models

- Dynasmart
- Dynamec
- Cube Avenue

DTA Model Characteristics

- Network detail less than traffic simulation
- Uses OD Tables for loading-matrix estimation
- Sub Region to Regional in Scale
- Can evaluate traffic control
- Represents queuing
- Potential as 4th Step of Modeling Chain

Dynasmart-P

- Most Applications to date
- Used for BMC Redundancy Study
- El Paso MPO using as 4th Step in Regional Model
- SCAG evaluation-Los Angeles
- Regional and Corridor ITS Planning
- More research required in driver compliance to information

Traffic Simulation vs. DTA (Mesoscopic)

- Traffic simulation used successfully for decades
- 3D animation popular with decision-makers
- Traffic simulation extremely labor-intensive
- Mesoscopic DTA based on user equilibrium assignment *and* simulation
- Mesoscopic DTA uses time-dependent OD matrices
- Mesoscopic DTA less labor-intensive

Questions?